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Development of a Navy Hearing
Conservation Management
Information System (HECMIS)

R. M. Robertson and C. E. Williams

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November 1984

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
PENSACOLA, FLORIDA.

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DEVELOPMENT OF A NAVY HEARING CONSERVATION
MANAGEMENT INFORMATION SYSTEM (HECMIS)

R. M. Robertson and C. E. Williams

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NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
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SUMMARY PAGE

THE PROBLEM

Currently, naval hearing conservation management personnel cannot assess the adequacy of their programs because of the lack of an efficient and economical way to obtain the necessary data from medical records.

FINDINGS

This report describes the development of a model Hearing Conservation Management Information System (HECMIS) which has been delivered to the Navy Environmental Health Center (NEHC), Norfolk where it is undergoing further operational modeling. The HECMIS, which now contains data elements from some 19,000 DD-2215 forms and 12,400 DD-2216 forms, will be used initially by hearing conservation staff at NEHC as a management tool and to disseminate to field activities the information considered necessary for the efficient operation of their hearing conservation programs. When implemented, the HECMIS, in conjunction with microprocessor-controlled group audiometers soon to be acquired for use in Navy hearing conservation programs, will provide hearing data of superior reliability and a means by which Navy hearing conservation management personnel can derive the critical information necessary to determine the adequacy and efficiency of their hearing conservation programs.

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INTRODUCTION

A maximally efficient and effective Navy Hearing Conservation Program requires accurate and reliable individual and group audiometric data, the administrative structure to act upon the data in the manner defined in current NAVMEDCOM and OPNAV directives (1,2), and an effective computer based management information system. Without these elements and their proper interaction, the identification of Navy military and civilian workers who exhibit noise induced hearing losses and the identification of naval environments which are hazardous to hearing are virtually impossible. Moreover, the consequences of not having these integrated elements can be costly, both in human and economic terms. Whereas the human cost is impossible to assess, the latter can be estimated on the basis of hearing loss compensation claims. Claims paid through 1978 when none of the aforementioned elements existed in the Navy, amounted to $114,000,000 (3).

Many of the problems in military audiometry identified and discussed by the National Academy of Sciences' Committee on Hearing and Bioacoustics (CHABA) at a symposium in 1955 (4,5) still existed in the late 1970s (6). Earlier attempts to establish procedures for obtaining accurate and reliable hearing threshold information from group audiometric tests were considered inadequate (7), including the widespread use of self-recording audiometry which, in 1976, prompted the Navy's Bureau of Medicine and Surgery (Chief, BUMED) to direct naval activities to refrain from purchasing self-recording audiometers and to limit group testing to four subjects (8). In addition to problems with the reliability of hearing test results derived from existing types of audiometric equipment and problems with the equipment's maintainability, there were also critical administrative and management problems. Compiling hearing threshold information from thousands of scattered medical records was virtually impossible. Without an efficient and economical way to obtain necessary data from medical records, operational pesonnel could not assess the adequacy of their hearing conservation programs.

The resolution of these problems became possible when manufacturers applied advances in microprocessor logic components to individual and group audiometers, thus enabling the implementation of accurate and reliable automatic hearing testing. The various audiometric data acquisition, storage and retrieval options available with such devices provided the means by which a standardized approach to data management for hearing conservation could finally be realized. Air Force personnel at Brooks Air Force Base demonstrated the advantages and potential of a central hearing conservation data bank (9), and a number of companies in the private sector demonstrated the utility of the concept.*

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*For example, the Audiometer Corporation of America, Phoenix, AZ and Impact Hearing Conservation, Inc., Kansas City, MO.

In an effort to aid the Navy Environmental Health Center in its quest to establish effective and efficient hearing conservation procedures, and in response to the expressed desire of Chief, BUMED to see a program move forward in this area (10), the Naval Medical Research and Development Command (NMRDC) directed the Naval Aerospace Medical Research Laboratory (NAMRL) to:

   (a) conduct an exploratory assessment of microprocessor-controlled audiometers (MCAs);

   (b) develop specifications for a microprocessor-controlled group audiometer (MCGA);

   (c) develop a computer based hearing conservation management information system responsive to both operational and research requirements.*

A laboratory and field assessment of four MCAs (6) demonstrated that the new generation of audiometers produce, within acceptable variation, hearing threshold levels comparable to those obtained with manual audiometry and within similar time frames. Not only can any threshold-seeking procedure be programmed** and standardized (at all test locations), the audiometers can also be prorammed to: (a) provide fault detection algorithms which make it difficult for individuals to falsify audiometric data; (b) perform data analysis on current hearing threshold levels; (c) define significant threshold shifts since the previous monitoring period; and (d) analyze other parameters deemed necessary by the user. Since data are obtained in digital form, the output can be stored on digital devices (tape, disk, etc.) and transferred by telephone lines to a central computer facility. The proper interfacing of such

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devices with a regional or central computer would aid significantly in the execution and management of a variety of tasks within the purview of the Navy's Hearing Conservation Program.

Following NAMRL's exploratory assessment of the MCAs (6), specifications were developed for contractor construction of four MCGA prototypes and a parallel effort was initiated toward the development of a model hearing conservation management information system. When the contractor that had been selected to construct and deliver the MCGA prototypes could not do so in the allotted time frame, the contract was cancelled and the Navy Environmental Health Center initiated action to acquire production model MCGAs (from audiometer manufacturers who had, in the meantime, developed MCGAs on their own). Many of the MCGA specifications developed by NAMRL will be incorporated in the new units. The MCGAs will provide fully automated hearing testing for up to ten people simultaneously, will allow technician cueing as to appropriate follow-up on each person tested, and will digitize the information for both local storage (on diskette) and transmission to a Hearing Conservation Management Information System.

This report describes the development of a model Hearing Conservation Management Information System (HECMIS) which has been delivered to the Navy Environmental Health Center for further operational modeling.

EARLY DEVELOPMENT AND SYSTEM ANALYSIS

Overall requirements for a hearing conservation management information system and several alternative system designs were studied under contract by a systems analyst at the Navy Regional Data Automation Center (NARDAC), Pensacola, Florida. Following an analysis of two systems, the UNIVAC DMS 1100 system and a MUMPS-based system (Massachusetts General Hospital Utility Multi-Programming System), the NARDAC analyst recommended the UNIVAC DMS 1100 system (14). The estimate for analyst/programmer labor was 64 man months; total system development was estimated to cost $150,000. The alternative of leasing telecommunications equipment to communicate with a central computer containing a MUMPS-based "programmerless" data base development software system was not presented. Such a system was subsequently tested at NAMRL and selected as the most cost effective and efficient alternative.

A general purpose, interpreted programming language, MUMPS is designed for interactive data management applications. The language features a comprehensive set of operators and functions for the manipulation of variable-length string data and a symbolically referenced, hierarchically structured global data base for ease in the development, maintenance and management of large complex file structures. It is a high-level programming system that includes (in an integrated syntax and semantics):

a machine-independent, problem orienting programming
language

an operating system control language

a general purpose function library

a data management system

a telecommunications control function

a set of software tools for system design, development,
maintenance, error diagnosis, and program debugging

The interactive data management utilities that are an integral
part of the standard specification of the programming language
system facilitate the rapid development and change of data bases.
Through its string subscripting capability and balanced multi-way
tree design, the hierarchical file structure with automatic
compacting of physical files for sparse arrays provides automatic
indexing and sorting of data element categories. The string
handling syntactic elements facilitate the manipulation of
textual data through searching for particular characters,
character sets and patterns, and then segmenting or concatenating
strings according to the desired pattern. As a multi-programming
operating system, the shared access to central data bases (with a
security system for authorized levels of access) facilitates the
concurrent interaction of many individuals with a common,
dynamically updated data base.

DATA BASE DEVELOPMENT SOFTWARE STRUCTURE - DATASCAN

The "programmmerless" software used in the development of
HECMIS is called Datascan, a proprietary product of Vista
Computer, Inc., Elmsford, New York. A user-friendly, menu-
driven, dictionary based system written in MUMPS, Datascan is
easily learned with step-by-step flows providing prompts and
messages as needed (15). The following sequence of steps is
followed:

Data names are defined for each of the data elements in
the data base

Menu and data entry screens are defined

The following modes are selected from the Datascan
master menu: data entry mode; query mode; report
preparation mode; report printing mode

Thus, Datascan is a complete data base development and management
system. With its flexible file formats, files are easy to change
or restructure and variable length fields and records eliminate
restrictions and problems with fields that are not large enough.
By completing only one set of English-language prompts, multiple
updates can be performed for a particular data item. Moreover,

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records can be updated across different files and individual data items can be updated in a variety of ways (e.g., items can be replaced, constant values can be added, and data item values can be subtracted from other data item values). A prototype system can be easily installed to allow agreement and confirmation of system design during system development, helping to insure end user acceptance with minimal risks. By enabling fast implementation and easy-to-make changes and allowing significant file design and procedural revisions (both during system development and after implementation), Datascan reduces end user changes and overall project costs. All system documentation, such as the data dictionary and screen definitions, can be printed or viewed in a readable format, making it easy to solve system development problems and thereby eliminate high revision costs.

Datascan allows quick retrieval of data and its flexible report generator allows production of both standard and special request reports as they are required. One very powerful capability of Datascan is that of being able to call up a pre-prepared report format through the query mode. This is especially helpful if extensive information is required for a particular purpose but very limited information is available to retrieve it.

CONTENT AND STRUCTURE OF HECMIS

The content and structure of HECMIS evolved when Datascan was utilized in an on-line mode during a five-month lease period (approximately five hours a week). Commercial telephone lines were used to communicate with the computer mainframe at White Plains, New York (now located at Elmsford, New York). Data transfer was at 1200 baud. Subsequently, FTS lines were used at the same baud rate with no difficulty.

The data element dictionary for HECMIS, containing the names of every discrete component within the data base, can be seen in Appendix A-1. Every effort was made to structure the names logically to reflect, as meaningfully as possible, the actual data fields they represent. Having understandable and readily identifiable data names is important because of their frequent usage, both in the query mode and in the structure of report definitions.

The main Datascan selection menu and the data entry/view/change/delete menu for the HECMIS are shown in Appendix A-2. Although the HECMIS menu is labeled 'data entry,' the associated functions just mentioned (view/change/delete) can be accomplished by calling up the appropriate screens.

The HECMIS data entry menu permits data to be entered into a number of modules on-line. The modules are:

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Reference audiogram - a reproduction of the data
elements contained in DD Form 2215 (See Appendix B)

Hearing conservation data - all monitoring audiograms
obtained annually on all personnel deemed 'at risk'
(See DD Form 2216, Appendix C)

Certified Examiners - contains information on all of
the Audiometric Technicians who are trained and quali-
fied to do hearing testing throughout the Navy

Reviewer dictionary - contains the names of individuals
who are responsible for reviewing the DD Forms
(generally first line supervisors having important
management roles in local hearing conservation
programs)

Inventory of Navy audiometric equipment*

Audiometer status file - used by repair and calibration
staff at NEHC to keep track of manhours and the cost of
repair, calibration and maintenance of audiometric
equipment

The on-screen format of the above modules, which permit data
entry, viewing, change or deletions, can be seen in Appendix D.

A number of output reports which present logical hard copy
arrangements of data residing in the various modules, have been
designed for HECMIS. Each report contains some, or all, of the
data elements represented in the individual modules. For
example, the report entitled "Members Receiving Monitoring Tests"
contains the name, date of birth, rating, unit identification
code (UIC), purpose of test, and identification number (ID) of
each individual included. The ID number, a concatenation of the
individual's social security number and the date of the
examination, pinpoints a specific file for a particular
individual.

Due to the extreme flexibility of Datascan's report
generator function, any type of report can be designed to contain
whatever data elements desired, in any format. Titles of reports
designed thus far are:

- Audiometer Inventory
- Audiometer Status Report
- Certified Examiners
- Examiners on DD-2216 Forms
- Examiners on DD-2215 Forms
- Hearing Protection Data

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*At present there are over 1200 audiometers in the data base.

- Members Receiving Monitoring Tests
- Members with Negative Threshold Shifts
- Members Receiving Reference Tests
- Members to be Retested next month
- Members with Significant Threshold Shift
- Monitoring Audiogram Thresholds
- Reviewer Directory
- Reviewers on DD-2216 Forms
- Reviewers on DD-2215 Forms
- Reference Audiogram Thresholds
- Threshold Shift Values

One of the most valuable reports in terms of operational management that can be generated from the data base is the report entitled "Members with Significant Threshold Shift." Whether or not an individual's hearing is deteriorating is key information that can aid management staff in determining their program's effectiveness and in pinpointing specific problems in their program. For example, an unusually high prevalence of hearing loss at a particular installation would serve as a red flag to management personnel so they could study the location and determine if there were an easily solvable noise control problem (thus, the data base can be utilized as an indirect tool to look at noise control engineering procedures), or whether the problem might be due to poor personnel hearing protection (e.g., poorly maintained protectors, inappropriate protectors for the type and level of noise, etc.) or poor administrative control over personnel noise exposure. In those instances where engineering control measures have been maximally implemented and hearing protection has been applied but is not adequate to meet the damage risk criteria for the work day, administrative control measures may require that workers in a particular noise environment be rotated with other workers to limit their noise exposures. Thus, "Members with Significant Threshold Shift" is a very critical report, one that will undoubtedly be utilized heavily by management staff at NEHC. (All report formats can be seen in Appendix E).

Besides being used by NEHC staff, the reports will also be utilized eventually to distribute information to regional occupational health officers for their use in making local hearing conservation management decisions.*

PRESENT STATUS OF HECMIS

The model HECMIS (along with complete system documentation) was delivered to NEHC, Norfolk in October 1981 where it is still undergoing further operational modeling. The model, presently being implemented through batch loading from tapes prepared by key punching data from hearing conservation forms, now contains

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*The powerful interactive query mode of Datascan will be extremely useful to NEHC staff responding to hearing conservation management questions. Queries can be made without any additional programming.

some 19,000 DD-2215 forms and 12,400 DD-2216 forms. It is anticipated that NEHC will initiate preparations in the near future to bring the entire system inhouse.

Looking to the future, the functional relationship that may ultimately exist between HECMIS and the Navy Occupational Health Information Monitoring System - NOHIMS (16) - is not clear at the present time. Since both HECMIS and NOHIMS are MUMPS-based systems, communication between the two systems could be established at such time as deemed essential by NEHC and the Regional Medical Centers.

CONCLUSIONS

Currently, Navy hearing conservation management personnel cannot assess the adequacy of their programs because of the lack of an efficient and economical way to obtain the necessary data from medical records. The HECMIS should alleviate this problem. When implemented, the HECMIS, in conjunction with microprocessor-controlled group audiometers (MCGAs) soon to be acquired for use in Navy hearing conservation programs, will provide hearing data of superior reliability and a means by which Navy hearing conservation management personnel can derive the critical information necessary to determine the adequacy and efficiency of their programs. The MCGAs will be operated by trained technicians at virtually every branch clinic throughout the world to test the hearing of the nearly 900,000 military and civilian personnel estimated to be at risk. The HECMIS will be used initially by hearing conservation staff at NEHC as a management tool and to disseminate to field activities information considered necessary for the efficient operation of their hearing conservation programs.

The availability of a hearing conservation data base at NEHC, Norfolk will permit hearing loss prevalence studies to be conducted on a continuing basis in a very cost effective manner. This will be in marked contrast to previous field studies that often required a year to complete (17). Research access to such a data base via an interactive computer terminal at NAMRL will permit continuing review of concepts in the areas of damage risk criteria, hearing protector design, administrative control paradigms, and, indirectly, engineering noise control.

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APPENDIX A-1

HECMIS DATA ELEMENT DICTIONARY

a. Audiometer and audiometer status data names

b. Monitoring audiometry (DD Form 2216) data names

c. Reference audiometry (DD Form 2215) data names

d. Reviewer data names

e. Examiner data names

a. Audiometer and audiometer status data names

Data Index

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=====================================================================
Index Name                                    Multiple?    Data Type
=====================================================================
AU,CAL                                            N          KEY
AU,CALNO                                          N          KEY
AU,CALREPNO                                       N          ID
AU,COND                                           N          KEY
AU,COST                                           N          KEY
AU,HRS                                            N          KEY
AU,MOD                                            N          KEY
AU,MOD/SER                                        N          KEY
AU,REPNO                                          N          KEY
AU,SER                                            N          ID
AU,STAT                                           N          KEY
AU,TECH                                           N          KEY
AU,TYPE                                           N          KEY
AU,UIC                                            N          KEY
AU,UICAL                                          N          KEY
```

b. Monitoring audiometry (DD Form 2216) data names

Data Index

Index Name	Multiple?	Data Type
M, CALAU	N	KEY
M, CERTX	N	KEY
M, CIVGRADE	N	KEY
M, CON	N	KEY
M, CURDATE	N	KEY
M, DOB	N	KEY
M, DODCOMP	N	KEY
M, FOREIGN	N	KEY
M, ID	N	ID
M, L1	N	COMMENT
M, L2	N	COMMENT
M, L3	N	COMMENT
M, L4	N	COMMENT
M, L5	N	COMMENT
M, L6	N	COMMENT
M, L7	N	COMMENT
M, LR1	N	COMMENT
M, LR2	N	COMMENT
M, LR3	N	COMMENT
M, LR4	N	COMMENT
M, LR5	N	COMMENT
M, LR6	N	COMMENT
M, LR7	N	COMMENT
M, MODAU	N	KEY
M, NAMEP	N	KEY
M, NAMERE	N	KEY
M, NAMEX	N	KEY
M, NECDESIG	N	KEY
M, NECRE	N	KEY
M, NECX	N	KEY
M, PAYGRADE	N	KEY
M, PURPOSE	N	KEY
M, R1	N	COMMENT
M, R2	N	COMMENT
M, R3	N	COMMENT
M, R4	N	COMMENT
M, R5	N	COMMENT
M, R6	N	COMMENT
M, R7	N	COMMENT
M, RATING	N	KEY
M, REFDATE	N	KEY
M, RR1	N	COMMENT
M, RR2	N	COMMENT
M, RR3	N	COMMENT
M, RR4	N	COMMENT
M, RR5	N	COMMENT
M, RR6	N	COMMENT
M, RR7	N	COMMENT
M, SERAU	N	KEY
M, SERVCOMP	N	KEY
M, SEX	N	KEY
M, SIGSHIFT	N	KEY
M, SL1	N	COMMENT
M, SL2	N	COMMENT

Data Index

Index Name	Multiple?	Data Type
M,SL3	N	COMMENT
M,SL4	N	COMMENT
M,SL5	N	COMMENT
M,SL6	N	COMMENT
M,SL7	N	COMMENT
M,SR1	N	COMMENT
M,SR2	N	COMMENT
M,SR3	N	COMMENT
M,SR4	N	COMMENT
M,SR5	N	COMMENT
M,SR6	N	COMMENT
M,SR7	N	COMMENT
M,SSNP	N	KEY
M,SSNRE	N	KEY
M,SSNX	N	KEY
M,TYPEAU	N	KEY
M,UICP	N	KEY
M,UICRE	N	KEY
M,UICX	N	KEY
M,ZIP	N	KEY

c. Reference Audiometry (DD Form 2215) Data Names

Data Index

Index Name	Multiple?	Data Type
R,CALAU	N	KEY
R,CERTX	N	KEY
R,CIVGRADE	N	KEY
R,CON	N	KEY
R,DATE	N	KEY
R,DOB	N	KEY
R,DODCOMP	N	KEY
R,DOUBPR	N	KEY
R,FOREIGN	N	KEY
R,FREQGLPR	N	COMMENT
R,GLASSES	N	KEY
R,HRSLAST	N	KEY
R,ID	N	ID
R,ISSUEPR	N	KEY
R,L1	N	COMMENT
R,L2	N	COMMENT
R,L3	N	COMMENT
R,L4	N	COMMENT
R,L5	N	COMMENT
R,L6	N	COMMENT
R,L7	N	COMMENT
R,MODAU	N	KEY
R,NAMEP	N	KEY
R,NAMERE	N	KEY
R,NAMEX	N	KEY
R,NECDESIG	N	KEY
R,NECRE	N	KEY
R,NECX	N	KEY
R,PAYGRADE	N	KEY
R,R1	N	COMMENT
R,R2	N	COMMENT
R,R3	N	COMMENT
R,R4	N	COMMENT
R,R5	N	COMMENT
R,R6	N	COMMENT
R,R7	N	COMMENT
R,RATING	N	KEY
R,REMARKS	N	COMMENT
R,SERAU	N	KEY
R,SERVCOMP	N	KEY
R,SEX	N	KEY
R,SIZEPR	N	KEY
R,SSNP	N	KEY
R,SSNRE	N	KEY
R,SSNX	N	KEY
R,TIME	N	KEY
R,TYPEAU	N	KEY
R,TYPEPR	N	KEY
R,TYPEREF	N	KEY
R,UICP	N	KEY
R,UICRE	N	KEY
R,UICX	N	KEY
R,ZIP	N	KEY

d. Reviewer Data Names

Data Index

Index Name	Multiple?	Data Type
RE,CERT	N	KEY
RE,DATECERT	N	KEY
RE,NAME	N	KEY
RE,NEC	N	KEY
RE,SSN	N	ID
RE,UIC	N	KEY

e. Examiner Data Names

Data Index

Index Name	Multiple?	Data Type
X,CERT	N	KEY
X,NAME	N	KEY
X,PRESLOC	N	KEY
X,RECERT	N	KEY
X,SSN	N	ID
X,UIC	N	KEY

APPENDIX A-2

DATA SCAN III MENU and HECMIS MENU

DATA SCAN III MENU

1. Define Your Data Names
2. Define Your Screens
3. Enter/View/Change/Delete Data
4. Query Your Data Base
5. Prepare Your Reports
6. Print Your Reports

HECMIS MENU

DATA ENTRY CHOICES

1. Reference Audiogram (DD-2215)
2. Hearing Conservation Data (DD-2216)
3. Audiometer Inventory
4. Audiometer Status
5. Certified Examiners
6. Reviewer Directory

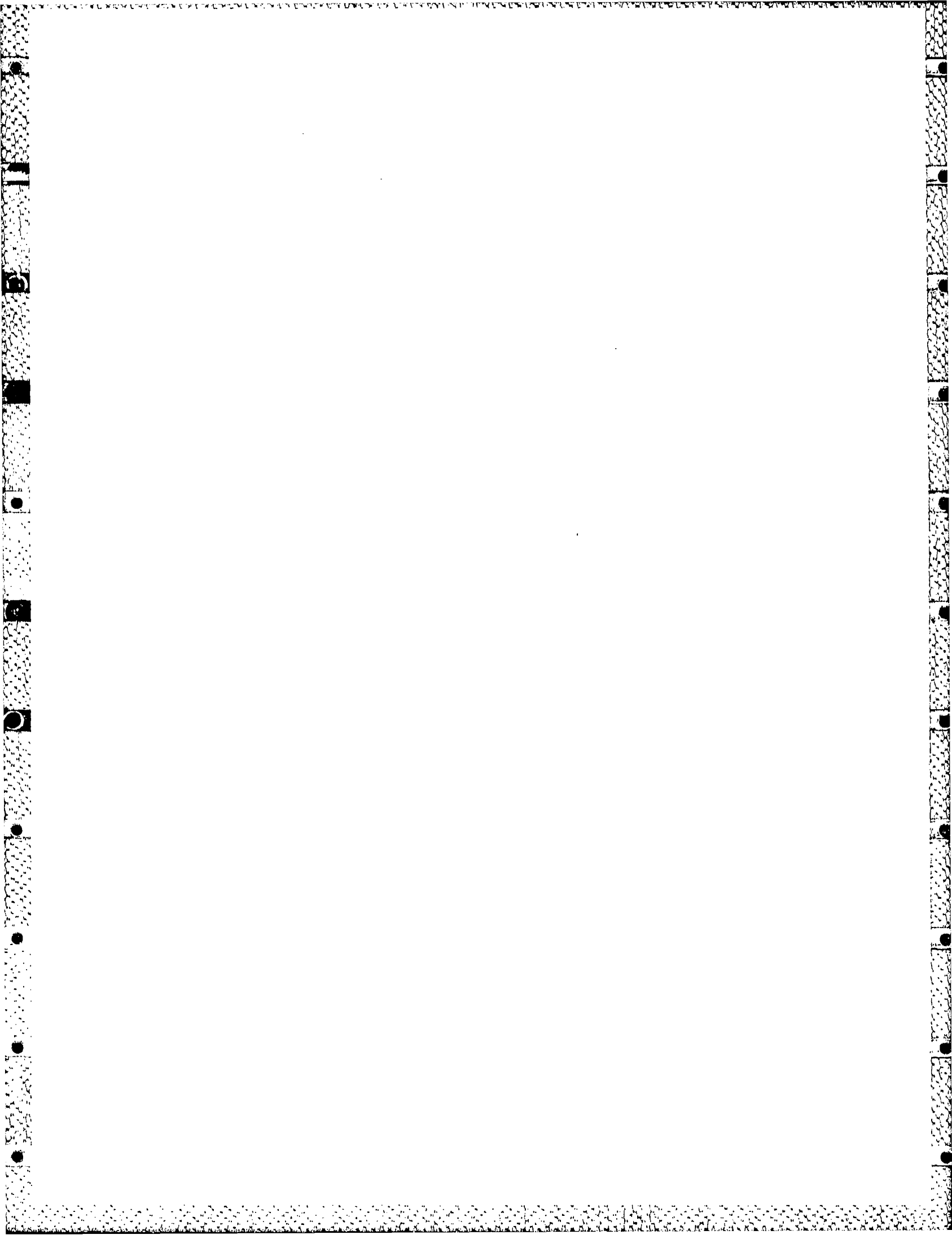   1. SELECT NUMBER OF CHOICE AND PRESS RETURN

APPENDIX B

DD Form 2215

REFERENCE AUDIOGRAM

ZIP CODE/APO ☐☐☐☐☐☐☐☐☐☐

DOD COMPONENT ☐
A—ARMY   M—MARINE CORPS
N—NAVY   1—OTHER DOD ACTIVITY
F—AIR FORCE

SERVICE COMPONENT ☐
R—REGULAR   G—NATIONAL GUARD
V—RESERVE   1—OTHER

PERSONAL DATA

SSN ☐☐☐ ☐☐ ☐☐☐☐

LAST NAME—FIRST NAME—MIDDLE INITIAL

SEX ☐	M—MALE F—FEMALE	DATE OF BIRTH			PAY GRADE, UNIFORMED SERVICES	GRADE, CIVILIAN	SERVICE DUTY OCCUPATION CODE
		year	month	day			

MAILING ADDRESS OF ASSIGNMENT

LOCATION—PLACE OF WORK	MAJOR COMMAND	DUTY PHONE

AUDIOMETRY

☐
1. REFERENCE ESTABLISHED PRIOR TO INITIAL DUTY IN HAZARDOUS NOISE AREAS
2. REFERENCE ESTABLISHED FOLLOWING EXPOSURE IN NOISE DUTIES
3. REFERENCE RE—ESTABLISHED AFTER FOLLOWUP PROGRAM

HEARING THRESHOLD LEVELS OF TEST FREQUENCIES RE: ANSI S3.6

LEFT EAR						RIGHT EAR					
500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000

DATE OF AUDIOGRAM			DAY OF WEEK			MIL-TIME-DAY	HOURS SINCE LAST NOISE EXPOSURE	ENT PROBLEM AT TIME OF TEST
year	month	day	☐ 1-SUN 4-WED 7-SAT 2-MON 5-THURS 3-TUES 6-FRI					☐ 1—NO 2—YES 3—UNKNOWN

EXAMINER

LAST NAME—FIRST NAME—MIDDLE INITIAL	TRAINING CERT NO. SSN ☐☐ ☐☐ ☐☐☐☐	SERVICE DUTY OCCUPATION CODE	OFFICE SYMBOL

AUDIOMETER

TYPE ☐ 1-MANUAL 2-SELF-RECORDING (automatic) 3-MICROPROCESSOR	MODEL	MANUFACTURER	SERIAL NUMBER	LAST ELECTROACOUSTIC CALIB DATE
				year month day

PERSONAL HEARING PROTECTION

TYPE USED ☐ 1-SINGLE FLANGE (V51R) 5-NOISE MUFFS 2-TRIPLE FLANGE 6-OTHER 3-HAND FORMED EARPLUGS 4-EAR CANAL CAPS	EARPLUGS ISSUED 1-NO 2-YES ☐ 3-PREVIOUSLY ISSUED	SIZE EARPLUGS R L 1-XS 2-S 3-M 4-L 5-XL	DOUBLE PRO TECTION USED ☐ 1-NO 2-YES	GLASSES WORN (including goggles) ☐ 1-NO 2-YES	FREQUENCY GLASSES WORN ☐ 1-ALWAYS 2-SELDOM 3-N/A

REMARKS

CONTENTS REVIEWED AND VALIDATED BY

NAME OF REVIEWER (Signature)	SERVICE DUTY OCCUPATION CODE	AUTOVON	SSN ☐☐ ☐☐ ☐☐☐☐	OFFICE SYMBOL

DD FORM 1 SEP 79 **2215**   B-1   S/N 0102-LF-002-2150

APPENDIX C

DD Form 2216

HEARING CONSERVATION DATA

ZIP CODE/APO [| | | | | | | |]

| DOD COMPONENT ☐ | A-ARMY N-NAVY F-AIR FORCE | M-MARINE CORPS 1-OTHER DOD ACTIVITY | SERVICE COMPONENT ☐ | R-REGULAR G-NATIONAL GUARD V-RESERVE 1-OTHER |

| SSN | LAST NAME—FIRST NAME—MIDDLE INITIAL | SEX ☐ | M-MALE F-FEMALE | DATE OF BIRTH year | month | day |

| PAY GRADE, UNIF SVCS | GRADE, CIVILIAN | SERVICE DUTY OCCUPATION CODE | MAILING ADDRESS OF ASSIGNMENT |

| LOCATION—PLACE OF WORK | MAJOR COMMAND | DUTY PHONE |

AUDIOMETRY

PURPOSE ☐   1—90 DAY   2—ANNUAL   3—TERMINATION   4—OTHER

AUDIOMETRIC DATA RE: ANSI S3.6	LEFT						RIGHT					
	500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

| 1-No Significant threshold shift 2-Yes (STS) 20dB or greater ☐ | STS NO | ● Counsel ● Return to duty ● Retest in 12 mo. | ● Validated by reviewer ● Orig in health record ● Send copy to registry | STS YES | ● Notify supervisor ● Followup No.1 after minimum 15 hours noise free |

| NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL |

| TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year | month | day |

FOLLOWUP NO. 1 ☐   Minimum 16 hours noise free

AUDIOMETRIC DATA RE: ANSI S3.6	LEFT						RIGHT					
	500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

| 1-No Significant threshold shift 2-Yes (STS) 20dB or greater ☐ | STS NO | ● Counsel ● Return to duty ● Retest in 12 mo. | ● Validated by reviewer ● Orig in health record ● Send copy to registry | STS YES | ● Notify Supervisor ● Cleared by medical reviewer before Followup No. 2 |

| NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL |

| TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year | month | day |

FOLLOWUP NO. 2 ☐   Minimum 40 hours noise free since Followup No. 1

AUDIOMETRIC DATA RE: ANSI S3.6	LEFT						RIGHT					
	500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000
CURRENT AUDIOGRAM DATE year month day												
REFERENCE AUDIOGRAM DATE year month day												
THRESHOLD SHIFT +=Poorer −=Better												

| Significant threshold shift (STS) 20dB or greater ☐ 1-No 2-Yes | STS NO | ● Counsel ● Return to duty ● Retest in 12 mo. | ● Validated by reviewer ● Orig in health record ● Send copy to registry | STS YES | ● Refer to appro directive ● Requires medical disposition | ● Validated by reviewer ● Orig in health record ● Send copy to registry |

| NAME OF EXAMINER (Last, first, MI) | TRAINING CERT NO. | SSN | SERVICE DUTY OCCUPATION CODE | OFC SYMBOL |

| TYPE ☐ 1-Manual 2-Self-recording (auto) 3-Microprocessor | MODEL | MANUFACTURER | SERIAL NO. | LAST ELECTROACOUSTIC CALIB DATE year | month | day |

| REVIEWED & VALIDATED BY: | SERVICE DUTY OCCUPATION CODE | AUTOVON | SSN | OFC SYMBOL |

APPENDIX D

HECMIS Data Entry/View/Change/Delete Screens

a. Audiometer Inventory

b. Audiometer Status

c. Monitoring Audiogram

d. Reference Audiogram

e. Reviewer Directory

f. Certified Examiners

g. Sample Screen Definition

a. Audiometer Inventory

1. MODEL/SERIAL NUMBER OF AUDIOMETER:

2. TYPE OF AUDIOMETER:

3. DATE OF LAST ELECTROACOUSTIC CALIBRATION:

4. LOCATION WHERE UNIT WAS CALIBRATED:

5. PRESENT LOCATION OF UNIT:

6. TECHNICIAN NUMBER:

7. AUDIOMETER STATUS:

b. Audiometer Status

1. PRESENT LOCATION OF UNIT:

2. MODEL/SERIAL NUMBER (JOIN BY /):

3. CALIBRATION OR REPAIR NUMBER:

4. COST:

5. MAN HOURS:

6. CONDITION CODE:

7. TECHNICIAN NUMBER:

c. Monitoring Audiogram

DD-2216
<<HEARING CONSERVATION DATA>>
-MONITORING AUDIOMETRY-

1. ZIP CODE OR APO:

<<PERSONAL DATA>>

2. DOD COMPONENT:

3. SERVICE COMPONENT:

4. SSN: 5. NAME:

6. SEX: 7. DOB:

8. PAY GRADE (MILITARY):

9. CIVILIAN GRADE:

10. SDOC:

<<AUDIOMETRY>>

11. PURPOSE:

12. CURRENT AUDIOGRAM DATE:

        LEFT EAR THRESHOLDS   RIGHT EAR THRESHOLDS

13. 500:   20. :

14. 1000:   21. :

15. 2000:   22. :

16. 3000:   23. :

17. 4000:   24. :

18. 6000:   25. :
19. 8000:   26. :
27. SSN AND REFERENCE AUDIOGRAM DATE (JOIN BY DASH):

        LEFT EAR THRESHOLDS   RIGHT EAR THRESHOLDS

28. 500:   35. :

29. 1000:   36. :

30. 2000:   37. :

31. 3000:   38. :

32. 4000:   39. :

33. 6000:   40. :

34. 8000:   41. :

D-3

(THRESHOLD SHIFTS)

LEFT EAR   RIGHT EAR

42. 500:   49. :

43. 1000:   50. :

44. 2000:   51. :

45. 3000:   52. :

46. 4000:   53. :

47. 6000:   54. :

48. 8000:   55. :

56. SIGNIFICANT THRESHOLD SHIFT?:
                        <<EXAMINER>>
57. SSN: 58. CERT.#:

59. NAME: 60. NEC: 61. UIC:

                        <<AUDIOMETER>>
62. SERIAL NUMBER: 63. MODEL:

64. TYPE: 65. CALIBRATION DATE:
                        <<REVIEWER>>
66. SSN: 67. NEC:

68. NAME: 69. UIC:
                <<RECORD IDENTIFICATION>>
70. ID:

71. UIC OF EXAMINEE:

72. RATING OF EXAMINEE: 73. CONTROL NUMBER:

d. Reference Audiogram

DD-2215

<<REFERENCE AUDIOGRAM>>

1. ZIP CODE OR APO:

<<PERSONAL DATA>>

2. DOD COMPONENT:

3. SERVICE COMPONENT:

4. SSN: 5. NAME:

6. SEX: 7. DOB:

8. PAY GRADE (MILITARY):

9. CIVILIAN GRADE:

10. SDOC:

<<AUDIOMETRY>>

11. TYPE OF REFERENCE:
        LEFT EAR   RIGHT EAR

12. 500:   19. :

13. 1000:   20. :

14. 2000:   21. :

15. 3000:   22. :

16. 4000:   23. :

17. 6000:   24. :
18. 8000:   25. :

26. DATE: 27. TIME:
28. HOURS SINCE LAST EXPOSURE:
                    <<EXAMINER>>

29. SSN:

30. CERTIFICATION NUMBER:

31. NAME: 32. NEC:

33. UIC:

<<AUDIOMETER>>

34. SERIAL NUMBER: 35. MODEL NUMBER:

36. TYPE:

37. CALIBRATION DATE:
                        D-5

<<PERSONAL HEARING PROTECTION>>

38. TYPE: 39. EARPLUGS ISSUED?:
40. SIZE (R):   52. SIZE (L):   41. DOUBLE PROTECTION?:
42. GLASSES WORN?:   43. FREQ. GLASSES WORN?:

<<COMMENT SECTION>>

44. REMARKS:

<<REVIEWER>>

45. SSN: 46. NEC:

47. NAME: 48. UIC:

<<RECORD IDENTIFICATION>>

49. ID:

50. UIC OF EXAMINEE:

51. RATING OF EXAMINEE: 53. CONTROL NUMBER:

e. Reviewer Directory

1. SSN:

2. NEC:

3. NAME:

4. UIC OF REVIEWER:

5. CERTIFICATION NUMBER:

6. DATE OF CERTIFICATION:

f. Certified Examiners

1. NAME:

2. SSAN:

3. CERTIFICATION NUMBER:

4. RE-CERTIFICATION NUMBER:

5. PRESENT LOCATION:

6. TRAINING UIC:

g. Sample Screen Definition

SCREEN NAME: AUDIOMETER

Field #: 1   Data Source is Input
             Required Variable Length : 15 Alpha-Numeric
             Updates : Replace SER,AU in this record

Field #: 2   Data Source is Input
             Required Fixed Length : 1 Alpha-Numeric
             Updates : Replace TYPE,AU in this record

Field #: 3   Data Source is Input
             Optional Variable Length : 0 Numeric Format :
             Updates : Replace CAL,AU in this record

Field #: 4   Data Source is Input
             Optional Variable Length : 0 Numeric Format :
             Updates : Replace UICAL,AU in this record

Field #: 5   Data Source is Input
             Optional Variable Length : 0 Numeric Format :
             Updates : Replace UIC,AU in this record

Field #: 6   Data Source is Input
             Optional Variable Length : 0 Alpha-Numeric
             Updates : Replace TECH,AU in this record

Field #: 7   Data Source is Input
             Optional Variable Length : 0 Alpha-Numeric
             Updates : Replace STAT,AU in this record

D-9

APPENDIX E

HECMIS Report Formats (Samples)

a. Audiometer Inventory
    (1) Report Definitions

b. Audiometer Status Report

c. Certified Examiners

d. Examiners on DD-2215/DD-2216 Forms

e. Hearing Protection Data

f. Members Receiving Monitoring Tests

g. Members with Negative Threshold Shifts

h. Members Receiving Reference Tests

i. Members to be Re-tested Next Month

j. Members with Significant Threshold Shift

k. Monitoring Audiogram Thresholds

l. Reviewer Directory

m. Reviewers on DD-2215/DD-2216 Forms

n. Reference Audiogram Thresholds

o. Threshold Shift Values

a. Audiometer. Inventory (Sample)

===

DATE	MOD/SERIAL NUMBER	TYPE AUD	STATUS	LOCATION	TECH NUMBER	WHERE CALIBRATED
830316	ARJ4A/797	A		68546	844	68546
830421	ARJ4B/1368	A		105	844	68546
831107	ARJ4B/239	A		00105	843	68546

a(1). Report Definitions (Sample)

REPORT DEFINITIONS   PAGE 1

REPORT NAME: AUDIOMETER   REPORT TITLE: AUDIOMETER INVENTORY   REPORT WIDTH: 80
COLUMN 10   20   30   40   50   60   70   80   90   100   110   120   130

	MOD/SERIAL	TYPE			TECH	WHERE
DATE	NUMBER	AUD	STATUS	LOCATION	NUMBER	CALIBRATED

3. PRINT POSITION # : 1	3. PRINT POSITION # : 12
4. HEADER TEXT : DATE	4. HEADER TEXT : NUMBER
5. 'PRINT' DATA NAME: CAL,AU	5. 'PRINT' DATA NAME: SER,AU
6. LOOK IT UP USING :	6. LOOK IT UP USING :
7. AS (ID-DATA NAME):	7. AS (ID-DATA NAME):
8. DATA TYPE (A/N/D): N	8. DATA TYPE (A/N/D): A
9. DECIMAL FORMAT : 6	9. DECIMAL FORMAT :
10. RECAP TYPES(CTAS):	10. RECAP TYPES(CTAS): C
11. SEQUENCE (Y/N) : N	11. SEQUENCE (Y/N) : N
12. PRINT DETAIL? : Y	12. PRINT DETAIL? : Y
13. NEW PAGE - HEADER:	13. NEW PAGE - HEADER:
14. NEW LINE - HEADER:	14. NEW LINE - HEADER:

b. Audiometer Status Report (Sample)

AUDIOMETER STATUS REPORT   PAGE 1

===

LOCATION	MOD/SER#	CAL/REP#	COST$	MAN HOURS	COND CODE	TECHNICIAN
22154	ARJ4A/4565	45675	98	12	2	4345
TOTAL:			98	12		

c. Certified Examiners (Sample)

===

NAME	SSAN	CERT #	RECERT NUMBER	PRESENT LOCATION	TRAINING UIC

===

				NAVFAC SEATTLE	68095
				RESCTR BOISE, ID	68095
				NAVFAC SEATTLE	68095

d. Examiners on DD-2216 Forms (Sample)
   (Same format for DD-2215 forms)

EXAMINERS ON 2216 FORMS   PAGE 1

===

NAME	SSAN	CERT #	VED	UIC

===

		8987	5678	7777
		8987	5678	7777
		810518	0699	1.04
		8987	5678	7777

e. Hearing Protection Data (Sample)

HEARING PROTECTION DATA   PAGE 1

==

PLUGS ISSUED	TYPE	SIZE R	L	DOUBLE PROTECTION	GLASSES WORN	FREQ GL-WORN	ID
1	3	2	3	1	2	3	
2	6	4	0	2	2	1	
0	3	0	0	0	0		

f. Members Receiving Monitoring Tests (Sample)

==

NAME	ZIP	OCCUP CODE	RATING	UIC	PURPOSE	ID
	32504		N/A	2223	2	
	25623	6632	MM	4415	2	
	65235	6632	TD	1012	1	
	69532	5621	HM	56894	3	

g. Members with Negative Threshold Shifts (Sample)

MEMBERS WITH NEGATIVE THRESHOLD SHIFTS   PAGE 1

NAME	UIC	PURPOSE	AUDION-SER#	ID
	11045	4	888	
	1212	4	232323	
	5652	2	25928	

h. Members Receiving Reference Tests (Sample)

==

NAME	ZIP	OCCUP CODE	RATING	TYPE REF	UIC	TYPE PROT	ID
	29408	0000	HM	2	7778	1	
	29408	0000	MM	2	5678	1	
	29408	0000	HT	2	1104	2	
	29408	0000	MM	2	1104	1	

i. Members to be Re-tested Next Month (Sample)

```
================================================================================

NAME                      UIC        ID
================================================================================

                          7896
                          8796
                          0091
```

j. Members with Significant Threshold Shift (Sample)

```
================================================================================

NAME                  UIC    PURPOSE   AUDIOM-SER#   ID
================================================================================

                      2325      2      889
                      11047     1      889
                      25642     2      888
```

k. Monitoring Audiogram Thresholds (Sample)

NAME	DATE	.5K R	.5K L	1K R	1K L	2K R	2K L	3K R	3K L	4K R	4K L	6K R	6K L	8K R	8K L
	810923	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	810911	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	810911	0	5	0	0	0	10	0	10	0	10	10	20	0	0
	811001	10	15	5	10	5	10	5	10	10	20	25	20	10	25

l. Reviewer Directory (Sample)

==

NAME	NEC	LOCATION	CERT #	CERT DATE

==

	4742	45456	382	A30605
	8914	5621	A10621	A10621
	9746	54557	6745	A10975

m. Reviewers on DD-2216 Forms (Sample)
(Same format for D-2215 forms)

==

NAME	SSDN	NEC	LOCATION

==

n. Reference Audiogram Thresholds (Sample)

==

NAME	DATE	.5K R	.5K L	1K R	1K L	2K R	2K L	3K R	3K L	4K R	4K L	6K R	6K L	8K R	8K L

==

	810526	15	20	10	20	5	20	10	15	10	25	15	25	0	0
	810522	5	10	20	10	0	0	15	15	25	25	25	25	0	0
	800627	10	15	5	10	10	20	0	20	5	20	20	30	0	0
	800623	10	15	5	10	5	10	5	20	10	20	25	25	10	0

o. Threshold Shift Values (Sample)

NAME	DATE	.5K R	.5K L	1K R	1K L	2K R	2K L	3K R	3K L	4K R	4K L	6K R	6K L	8K R	8K L

	810923	5	0	10	0	15	0	10	5	10	-5	5	-5	20	20
	810911	-5	-10	-20	-10	0	0	-15	-15	-25	-25	-25	-25	0	0
	810911	-10	-10	-5	-10	-10	-10	0	-10	-5	-10	-10	-10	0	0

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM

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	6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)
R. M. Robertson and C. E. Williams	

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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Hearing conservation,
Occupational medicine,
Hearing testing,
Reference and monitoring audiograms,
Hearing conservation data base,
Management information systems,
Microprocessor-controlled audiometers

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Due to the lack of an efficient and economical way to obtain essential data from medical records, naval hearing conservation management personnel lack the capability for assessing the adequacy of their programs. A model Hearing Conservation Management Information System (HECMIS) developed for the Navy Environmental Health Center (NEHC), Norfolk should alleviate this problem. The HECMIS, currently undergoing further operational modeling at NEHC, now contains some 19,000 DD-2215 forms and 12,400 DD-2216 forms. It will be used initially

DD 1 JAN 73 **1473** EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

by hearing conservation staff at NEHC as a management tool and to disseminate to field activities the information considered necessary for the efficient operation of their hearing conservation programs. When implemented, the HECMIS, in conjunction with microprocessor-controlled group audiometers soon to be acquired for use in Navy hearing conservation programs, will provide reliable hearing data and a means by which Navy hearing conservation management personnel can derive the critical information necessary to determine the adequacy and efficiency of their hearing conservation programs.

S N 0102- LF- 014- 6601